Financial Management and Risk Assessment of Electric Power Scientific Research Projects based on PDCA Analysis Method

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Keywords: Electric Power Enterprise, Science Technology Project, Financial Management, PDCA, Risk Analysis.

Abstract: The power industry is an important supporting industry of the energy revolution. Because of traditional energy demand, it is also facing industry innovation brought by various emerging technologies. Power grid enterprises have great demand for science and technology R & D, and the annual scientific research investment in the power industry reaches billion yuan. With the increase of science and technology R & D investment by power enterprises year by year, the demand for scientific and efficient management of science and technology project funds is becoming more and more urgent. By analysing the characteristics of science and technology project management in power enterprises, this study combs and discusses the management methods in each stage of science and technology project implementation by using PDCA analysis method. On this basis, the implementation risk of each stage is established and scored, and the risk level of risk control point is calculated. This study puts forward the optimization ideas and paths of financial management based on PDCA cycle theory, guides budget adjustment and project implementation through information feedback, and strengthens risk point control, which provides a practical reference for the practical application of financial management in scientific research project management.

1 INTRODUCTION

With the great leap forward development of science and technology in the world, the continuous expansion of the scale of investment in science and technology, the sharp increase in the number of scientific research practitioners, and the continuous great changes in the financial management mode of scientific research institutions and scientific research projects, all these have increased the difficulty of science and technology management and exposed many specific problems in management, It also gradually highlights various imperfections in professional management and internal control of scientific research projects. From the research situation at home and abroad, in the financial management research involving scientific research project management and performance appraisal, more attention is paid to the standardization and safety of fund use management. There are few theories and methods based on PDCA cycle theory and professional risk analysis tools to track the project progress from the perspective of management, and carry out research on the practical application of financial management such as scientific research project process management, auxiliary decision-making, performance appraisal and guiding budget preparation. This paper studies and analyses scientific research projects based on PDCA cycle theory. During the implementation of scientific research projects, starting with the analysis of the current situation and practical problems of financial management application, this paper analyses the objective practical problems, puts forward the optimization ideas and paths of financial management based on PDCA cycle theory, and focuses on the application of comprehensive budget method in budget preparation in the planning stage of scientific research projects, the dynamic change of financial data starts research and analysis on the optimization of project progress and performance evaluation, the establishment of a closely integrated financial management system between the project and the Research Institute, and the establishment of a 'industry finance integration' financial management system has important reference significance for the scientific research financial management of the research institute and scientific research projects.

Another remarkable feature of power science and technology project management is that science and

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technology projects have uncertainty, which exists objectively, as shown below:

1) The goal is uncertain. The creative characteristics of science and technology projects in power enterprises determine the important position of timeliness in research and development. In the process of implementation, due to the constraints of related technologies, the realization of R & D objectives of science and technology projects is limited. It is very difficult to grasp the planning control, fund control and quality control of science and technology project management. There are many unknown factors in the implementation, and there may be a certain gap between the research results and the expected objectives.

2) Technical uncertainty. With the development of information technology and intelligent technology, the technology with low maturity will increase the workload and difficulty of scientific research on the one hand, and increase the possibility of failure on the other hand. At the same time, the operability of some advanced technologies needs to be verified, so it may not produce the expected results for the scientific research projects.

3) The evaluation criteria are uncertain. The formulation of evaluation standards for traditional projects is relatively simple. It is necessary to calculate the deviation between the expected time and budget cost of the project and the specified standards. The evaluation indicators can be evaluated quantitatively according to the operation data. For power science and technology projects, the evaluation indicators are mostly non quantifiable indicators, and the evaluation index system is difficult to standardize and unify. Therefore, it is necessary to formulate corresponding evaluation standards for different types of projects, or conduct project evaluation by adding scientific and reasonable elastic indicators.

2 PDCA ANALYSIS METHOD FOR FINANCIAL MANAGEMENT

In the process of completing scientific research projects, funds must be used to ensure various labour consumption. Project financial management is to ensure that the scientific research project achieves the established objectives and carry out the financial management process and activities of the project within the budget prepared according to the project tasks. In order to carry out the financial management of scientific research projects objectively, scientifically and standardized, we must first establish the concept of "full life cycle cost management". PDCA is plan do check action. PDCA cycle is a scientific program that is managed in this order and goes on continuously. Using PDCA model, the control method of project management quality is shown in Figure 1, as follows.

1) The preparation of the budget for science and technology projects shall be carried out before or at the end of the science and technology project. The main methods are the analysis of the technical scheme of the project research, the basis for the preparation of funds, the law of fund use in the process of previous science and technology projects, the problems encountered and the experience in solving them.

2) Implement the financial management system of science and technology projects in the stages of science and technology project initiation, feasibility study and project implementation, and check the monthly, quarterly and annual use of funds during the implementation of science and technology projects.

3) In the closing stage of science and technology projects, it is necessary to analyze and sort out the inspection results in the process of each science and technology project, formulate the revision scheme of relevant science and technology project management system, complete the financial settlement and audit of project funds, and put forward the use of funds.

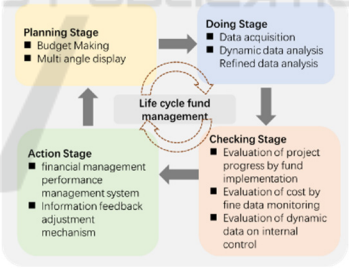

Figure 1: Cost elements of power science and technology project budgeting.

4) The cycle period is generally synchronized with the financial year, that is, once a year. In case of national policy adjustment or major problems in the management system of science and technology projects, a new cycle can be started at any time.

2.1 Plannning Stage

In the process of completing scientific research projects, funds must be used to ensure various labor consumption. Project financial management is to

ensure that the scientific research project achieves the established objectives and carry out the financial management process and activities of the project within the budget prepared according to the project tasks. In order to carry out the financial management of scientific research projects objectively, scientifically and standardized, we must first establish two basic management concepts of 'full life cycle cost management'. The comprehensive budget of scientific research projects shall be classified according to the accounting subjects involved in the completion of the project, and the relevant cost elements shall be clearly divided in each type of accounting subjects and analysed one by one. Cost elements are the basis of comprehensive budget preparation of scientific research projects, as shown in Table 1.

2.2 Doing Stage

For scientific research projects, building a scientific project financial management system can provide useful project information for project leaders and institute managers and effectively control project risks. Strengthening the management and analysis of refined financial data in project management will provide auxiliary decision-making for project progress.

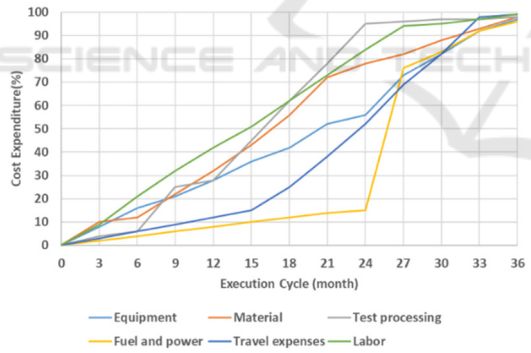

Figure 2: Reference for fund implementation rate of power science and technology projects.

2.3 Checking Stage

The current implementation of scientific research project funds is reflected by the budget implementation rate. The budget implementation rate is measured and determined by the ratio between the approved implementation amount of funds and the budget allocation amount when the project is completed. The ratio is the static data when the project is completed. The fund implementation rate reflects the difference between the actual expenditure of the project and the budget allocation, and cannot reflect the progress of the project. In order to evaluate the project progress from the perspective of fund implementation more comprehensively, scientifically and objectively, the evaluation standard of Dynamic Fund implementation on project progress should be constructed. Dynamic Fund implementation is to combine the current expenditure (or current budget implementation rate) during project implementation with the project plan implementation time to form the current fund implementation, which is used to evaluate the current project progress. At the same time, the budget implementation rates at multiple time points are used to evaluate the trend of project progress in one stage of the project implementation period. Figure 2 shows the fund implementation of general power science and technology projects, in which the project implementation cycle is three years.

2.4 Action Stage

After the completion of the project, the whole process multi-dimensional project financial management performance evaluation will help the project leader and institute managers summarize and accumulate project financial management experience, further improve the project management chain, and play an enlightening and guiding role in the future institute project management. The performance evaluation of project financial management should not only stay on the static financial data at the conclusion of the project, but also fully combine the dynamic financial data indicators in the process of project implementation to form a dynamic and static, comprehensive and reasonable evaluation system. At the same time, build the project financial management inspection and evaluation model in three aspects: fund implementation, project progress, refined financial data monitoring, project cost, whole process financial dynamic data and internal control, and form the project financial management performance evaluation system. The performance evaluation of project financial management should reflect the positive incentive effect, respect the labor achievements of scientific research workers, fully mobilize their work enthusiasm, change the passive situation of project financial management of the Institute, link performance with bonus and performance with promotion through evaluation, continuously improve the implementation effect of project funds and support the ability of scientific research project implementation.

Table 1: Cost elements of power science and technology project budgeting.

	Accounting subject	Cost element
Direct cost		
1	Equipment cost	Equipment purchase, trial production and leasing
2	Material cost	Instrument consumables and utensils, testing and analysis drugs and reagents, electronic components
4	Testing and processing fee	Test processing items 1, 2,...
5	Travel expenses	Research staff travel, invited experts travel, academic conference travel, transportation travel
6	Conference expenses	Project kick-off meeting, project demonstration meeting, review meeting, final acceptance meeting
7	International cooperation and exchange fee	International exchanges and visits, and invite foreign experts to visit and exchange
8	Publishing	Literature retrieval, data, publishing, intellectual property matters
9	Labor cost	The project employs technicians, master students, doctoral students and temporary employees
10	Expert consultation fee	Conference consultation
Indirect costs		
11	Indirect costs	Incentive of scientific research personnel, management expenses, daily water, electricity and gas consumption
12	Taxes	

3 RISK ANALYSIS OF SCIENCE AND TECHNOLOGY PROJECT MANA.GEMENT

3.1 Analysis of Risk Sources of Scientific Research Projects

R & D risk: because there are many uncertain factors in the research process of scientific research projects and the project covers a wide range, the progress of synchronous similar projects will affect the timeliness of the project, delay the project and insufficient time progress. At the same time, it should be considered that the uneven level of designers will also lead to problems in the links of the project, making it difficult for R & D and difficult to move forward. These are two important points in the R & D risk of the project.

Production risk: production risk is also a very important point in the project. In the first project procurement stage, due to the untimely procurement, the purchase of some key devices is slow, sometimes delayed for a year and a half. At this time, the whole project will stagnate. This problem is also often encountered in the progress of the project, constantly delaying the nodes and causing the accumulation of projects, If the purchase is not applied in time, it will take two to three years from development to production, so that the capital cannot be turned around. In fact, there are also correlations between various risks and contain each other. Second, a very important point in the production process is the process problem. For example, when making the structural chassis, the explosion connection problem caused by the dislocation of an empty or poor process level will also cause the project to be reworked continuously, and all aspects of coordination, communication and reprocessing will be carried out.

Risk management: from the previous risk type, we can think that coordination and communication also play a great role in the process of the project. For example, some design processes require the cooperation and guidance of designers from other departments, which requires good communication between department leaders to prevent being closed. Because some projects often have no interest in other departments, which leads to mutual push and quarrel, so it is very important to do a good job of communication and coordination.

Environmental risk: sometimes environmental risk should also be considered, because there is a certain probability, such as the transfer of department personnel, resignation, leave for business and other irresistible factors. If this happens, the project team leader should arrange other personnel to take over in time, which will lead to time delay and lack of understanding of the project situation, requiring continuous consultation and communication, It will affect the progress of the whole project.

Financial risk: first, in terms of contract management, including the lack of prior qualification examination or lax examination by the contract signing party; The wording of the agreed terms of the contract is not clear or the agreement is not clear enough, so that the legal binding force of the contract

is not strong; Lack of in-process tracking and implementation effect tracking during contract implementation; The signing and performance of some contracts are not strict, and the contract terms of the same matter are contradictory, etc. Second, budget management. Lack of budget execution analysis and assessment management, and failure to carry out real-time tracking, process supervision, feedback and early warning in the actual expenditure process of scientific research funds. Such as illegal expenditure, inflated expenditure, excessive use of budget, sudden spending, misappropriation of funds, etc.

3.2 Risk Identification and Assessment Implementation

Table 2 shows the risk objective level, the management process is the criterion level, and the key control points are the index level. A hierarchical structure model is established, in which {*B1, B2, B3, B4, B5, B6*} is the first level risk control points {*C11, C12, C13*}, {*C21, C22, C23, C24*}, {*C31, C32, C33, C34*}, {*C41, C42, C43*}, {*C51, C52, C53*}, {*C61, C62, C63*}. It is a secondary risk control point. After establishing the hierarchical structure index system, the importance standard of quantitative index is formulated, and the judgment matrix is constructed according to the subordinate relationship between the upper and lower levels.

1) Calculate the product Mi of factors in each row of the judgment matrix

$$M_j = \prod_{i=1}^{n} u_{i,j} (j = 1,2,\dots,n) \quad (1)$$

$$w_j = \sqrt[n]{M_j} \quad (2)$$

Normalization,

$$\bar{W} = w_j / \sum_{j=1}^{n} w_j \quad (3)$$

2) Calculate the random consistency index

$$\lambda_m = \sum_{j=1}^{n} \frac{(AW)_j}{nW_j} \quad (4)$$

$$CI = \frac{\lambda_m{}^{-n}}{n-1} \quad (5)$$

$$CR = CI/RI \quad (6)$$

R represents the average random consistency index.

3) On the basis of the constructed ladder level, experts are invited to compare and score the elements of each level, and calculate the judgment matrix of each index on the primary risk points *B1, B2, B3, B4, B5, B6,* as well as the secondary risk points *C11, C12 , C13... C63*, each judgment matrix passes the consistency test. Finally, the risk proportion of sub objectives and indicators at the business level is counted.

4) Through comprehensive analysis, the weighted possibility of different levels of risk in each index is obtained, and the risk level of the risk control point of the university is obtained. In Table 2, H represents high risk, M represents medium risk and D represents low risk. For example, the weighted probability of high risk in contract signing risk *C11* is 0.0061, the weighted probability of high risk in contract performance risk *C12* is 0.0053, the weighted probability of low risk in market recognition and evaluation risk *C13* is 0.0068, and so on. The risk level of each key control point in the project level management process can be calculated. According to the calculation results, control the points evaluated as high risk.

Table 2: Risk evaluation hierarchy index of scientific research projects in power enterprises.

	Level 1 risk/B	Level 2 risk/C	Risk indicators	Risk type
Project risk/ A	Project contract/ B1	Contract signing risk /C11	0.0061	H
		Contract performance risk /C12	0.0053	H
		Market identification and assessment risk/ C13	0.0068	L
	Project revenue and expenditure/ B2	Subcontracting risk/ C21	0.0132	D
		Authorization risk/ C22	0.0087	D
		Income source risk /C23	0.0092	D
		Business expenditure risk/ C24	0.0051	H
	Project budget/ B3	Budgeting risk/ C31	0.0061	L
		Budget approval risk/ C32	0.0058	D
		Budget execution risk /C33	0.0063	H
		Budget adjustment risk /C34	0.0077	L

	project implementation/ B4	Asset subscription risk /C41	0.0052	H
		Asset acceptance risk /C42	0.0052	D
		Asset collection risk/ C43	0.0081	L
	Scientific research procurement/ B5	Business expense risk/ C51	0.0069	H
		Procurement plan risk /C52	0.0067	D
		Procurement activity risk/ C53	0.0054	H
	Project acceptance/ B6	Risk of final account preparation/ C61	0.0082	L
		Audit risk/ C62	0.0072	H
		Post assessment risk/ C63	0.0091	D

4 CONCLUSION AND PROSPECT

In view of the growing demand for scientific research projects in the power industry, this study uses the PDCA cycle theory and the concept of life-cycle cost management of scientific research projects, puts forward the financial management framework for electric power science and technology projects, and studies and analyzes how to scientifically prepare the fund budget of scientific research projects by using the method of comprehensive budget. Through the quantitative analysis of financial data in project implementation, the implementation process of scientific research project funds is monitored, and the financial management methods of project auxiliary decision-making and performance evaluation are put forward. Through information feedback to guide budget adjustment and project implementation, further reduce the work burden of power R & D personnel, mobilize the work enthusiasm of scientific researchers, and provide a practical reference for the practical application of financial management in the scientific research project management of the Institute. Through information feedback to guide budget adjustment and project implementation, strengthen risk point control, and provide a practical reference for the practical application of financial management in scientific research project management. With the application of information technology means, the financial management means for scientific research projects have been further developed to achieve a more scientific, efficient and accurate financial management model.

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